is really to test the accuracy of formulæ, mostly arrived at by theoretical considerations; the work is therefore purely deductive, and not inductive. Yet it is difficult to see how to make the work covered by these notes anything but deductive; certainly no better system of teaching practically the elements of electrical engineering has so far been developed.

By means of Dr. Fleming's notes and a little oral assistance now and then, the student will be able to perform instructive experiments, and will be taught to observe closely, and to record his results neatly. The method followed facilitates the work of the demonstrator and the student, and enables a large amount of practical work to be carried out in a comparatively short time.

Microbes and Disease Demons. By Dr. Berdoe. Pp. 93. (Swan Sonnenschein and Co., 1895.)

UNDER the above sensational title the writer discusses, or rather attacks, the anti-toxin treatment of diphtheria. It is difficult to understand what has prompted the production of so prejudiced and, we regret to say, unscientific comment upon this subject. We most emphatically take exception to such expressions as "scientific quackery," and others of a similar character, being applied to investigations of which, although the therapeutic value may be as yet a question of opinion, undoubtedly mark a new step forward in our endeavour to unravel the problems surrounding disease.

We have no intention of discussing Dr. Berdoe's views in detail, but we feel ourselves called upon to refer to one statement, because the writer has used it as a vantage ground for his most savage attack upon this method of treating diphtheria. We refer to the death in Brooklyn alleged to have resulted from the injection of some of the anti-toxin. Several pages are devoted to a detailed account of the incidents of the case, and Dr. Berdoe does not hesitate to designate it as "sudden death from anti-toxin." This, however, is not the view of the Brooklyn Health Department, or of authorities in the Bacteriological Laboratory of the New York City Board of Health, in both of which institutions the anti-toxin used was submitted to a very careful and exhaustive examination, and the official opinion given that it was not responsible for the death of the patient.

The case for or against the anti-toxin treatment of diphtheria is not one which should be approached from a party point of view, and such prejudiced, vaporous effusions as Dr. Berdoe has permitted himself to indulge in, will never take any part in deciding the question of its efficiency. To arrive at any such positive conclusion is of necessity a matter upon which time and experience can alone give the final verdict, and its discussion should only be entrusted to those who are capable of approaching the subject in a scientific and judicial spirit.

Men-gu-yu-mu-tsi; or, Memoirs of the Mongol Encampments. Translated from the Chinese by P. S. Popov, Russian General Consul at Peking. 580 pp. (*Memoirs of the Russian Geographical Society*, vol. xxiv.; Russian.) (St. Petersburg, 1895.)

THIS is the work of two Chinese men of science, Chjan-mu, or Shi-chjou, author of a history of Jinghiz khan's conquests, and Khe-tsyu-tao, author of several geographical works, of which the description of the northern borderlands is best known. It was published in China in 1867, and consists of two parts: a description of the different tribes and confederations into which the Mongols are divided, with short notes on the extent of the territories they occupy, and short historical notices—the whole covering only about 160 pages of the Russian edition—and a great number of most interesting footnotes, which cover more than two-thirds of the volume, and contain a great variety of miscellaneous geographical and historical information.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

University of London Election.

I HAVE read the letters which Mr. Bennett, Mr. Thiselton-Dyer, and Prof. Ray Lankester have addressed you on the subject of the University of London, and much regret that my friends, whose opinion I value so much, take exception to one paragraph in my letter to Prof. Foster. I do not wish to seem to treat their views with any want of respect, and perhaps, therefore, you will allow me to send a few lines in reply.

They all criticise the sentence in which I state that I should endeavour to maintain the right of Convocation given in the Charter, which expressly provides that no alteration should be made in the constitution of the University without the assent of Convocation.

Prof. Ray Lankester says that "Sir John Lubbock has adopted and made himself the leader of this extraordinary and fantastic policy." Whether it is extraordinary and fantastic or not, is of course a matter of opinion, but, at any rate, it is the law at present.

I am satisfied that my constituents highly value this right, and I fail to understand how Mr. Thiselton-Dyer has been able to persuade himself that in endeavouring to maintain it I am taking a line "not courteous to Convocation," or have given "Convocation the severest slap in the face it has ever received."

Prof. Ray Lankester also says that I "have shown an unfavourable estimate of the intelligence" of my constituents. This is such an extraordinary version (not to say perversion) of what I said, that I trust you will allow me to quote my own words. What I said was—

"Feeling that Convocation ought to be consulted on a matter so vitally affecting the University, I should strongly urge, and would do my best to secure, that the scheme when arranged should be submitted to Convocation for their approval, to be signified as at a senatorial election, and would oppose the Bill unless this were conceded."

Why should this proposal appear to my friends as being, in Mr. Bennett's words, fatal to "all hopes of bringing our University into line with the requirements of the age"? The Commissioners will either propound a wise scheme or an unwise one. My critics believe that it will be wise. Why, then, should they assume that Convocation will reject it? At any rate it is an extraordinary reason for attacking me as a Member of Parliament, that I have faith in the good sense and sound judgment of my constituents. JOHN LUBBOCK.

High Elms, July 30.

Metrical Relations of Plane Spaces of n Manifoldness.

PLANE spaces of n manifoldness are assumed to have the following properties:—

(1) Given a S_{n-1} (a plane space of $n-1$ manifoldness) and a point P outside the same, then a certain S_n will exist which contains both the S_{n-1} and P.

It follows therefore that a S_n is determined by $n+1$ of its points, unless these points have that special situation to each other by virtue of which they are contained in a plane space of minor manifoldness.

(2) If a plane space S_n contains $n+1$ points, which have not the special situation to each other above mentioned, then it will contain the plane space S_n, determined by these points.

It therefore appears that $n+1$ points determine a S_n uniquely.

Given a straight line L and any point P upon the same: through L any number of planes can be constructed, each of which contains a certain line L′ through P perpendicular to L. The aggregate of such lines L′, in a space S_n form a S_{n-1}, which has that special position towards L by virtue of which it is called perpendicular to L in P.

To prove this theorem, which certainly holds if $n = 2$ or 3, let us assume that it is true when $n = k$; then it will also be true when $n = k + 1$. Through P, in a space S_k which contains L and is contained by S_n, construct the S_{k-1} perpendicular to L. Any point not contained in the S_{k-1} and L determines a plane, which contains the perpendicular PQ to L. PQ and the S_{k-1} determine a space S_k, and the proposition is that any line through P in this S_k is perpendicular to L. Through PQ construct a plane space Σ_{k-1} in S_k perpendicular to L. It must exist, according to hypothesis. S_{k-1} cuts the S_k into two parts, because every straight line in S_k (as easily follows from the assumptions) has one point in common with the S_{k-1}, we therefore have no means of passing from one point of such straight line to its other points without passing the S_{k-1}. S_{k-1} and Σ_{k-1} cut the S_k therefore into four different parts, which have the cut of Σ_{k-1} and S_{k-1}, that is a certain S_{k-2}, in common. Let the four departments, into which the S_k is cut, be called A, B, C, D. A straight line through P, not contained by the S_{k-2}, will be situated (as it passes P, that is a point of the S_{k-2}) in two different departments; and if we change the situation of this line continuously, without passing either the S_{k-1} or the Σ_{k-1}, it will remain in the same two departments. The departments are therefore arranged by two. If a straight line through P, belonging to A, also belongs to B, then A and B shall be called opposite to each other. Let A, B and C, D be opposite to each other. We have no means whatever of distinguishing two opposite departments, unless we assume at the very least another arbitrary point, because every plane configuration through the S_{k-2}, extending into one department, equally extends into the opposite one. Whatever is true for the one department must therefore be true also for the opposite one.

Now construct any line L′ through P in the S_k. Let L′ belong to A and B. If L and L′ are not perpendicular, then the angle LL′ contained in A must be larger or smaller than the corresponding angle LL′ contained in B. Let L′ change its position continuously; if the angle LL′ contained in A would be always larger than the corresponding angle in B, this would amount to a permanent property of A distinguishing it from B, which it cannot possess. Therefore, whichever evolution L′ may perform from the S_{k-1} to the Σ_{k-1} in A (and B), it must have at least one intermediate situation in which L and L′ are perpendicular. The aggregate of such situations form a surface in A and B. Let L′, . . . L'_{k-1} be $k-1$ lines contained in that surface; then the plane space of $k-1$ manifoldness containing these $k-1$ lines, must, according to the hypothesis, be perpendicular to L. The surface must therefore contain this plane space. If now we replace one of the two S_{k-1} or Σ_{k-1} by this space, the argument will still hold. However, near the two borderings plane spaces will finally approach, there will always be at least one intermediate plane perpendicular space, all of which are contained in the S_k. It is therefore nothing left but to concede that the S_k in question has the property established in the proposition.

Through any point P only one line L will pass, which is perpendicular to a space S. Assume indeed two such lines, which may have with S respectively Q and R in common. Then PQR would form a triangle, of which ∠ PQR as well as ∠ PRQ, according to the foregoing, will be = a right angle. This, however, is impossible, unless Q and R coincide.

A point and a plane space therefore determine a certain line, the perpendicular to that space through the point, a certain point —the one in which the line above mentioned cuts the space— and a magnitude, the distance of the two points above mentioned. This is always true, unless the point belongs to the space. Let the point approach the space. If the two points in question coincide, then the point will belong to the space. The conditions, therefore, that a point and a space are united, is (distance of point and space) = 0.

Let P move continuously so that its distance from a plane space S remains unaltered; P and S may determine a space Σ; then the aggregate of such points in Σ is another plane space. Let P and Q be two situations of P. Then all points of the line PQ have the same distance from S, as is easily seen to rest on Euclid's parallel axiom by means of parallelograms. The general proposition can, from this, be established by considerations analogous to the proof of our first theorem, independent of any new assumption. Two such spaces Σ and S are called parallel, and determine a certain magnitude, whose disappearance is the condition of coincidence of Σ and S.

Let Σ and S be parallel. Through any point A outside the same draw two lines, which cut both Σ and S, in B, C and B′, C′ respectively, then the lines ABB′ and ACC′ have a point in common, they are therefore in the same plane, BC and B′C′ must therefore either have a point in common, or be parallel. A point in common they have not, as they are contained in Σ and S, and these two have no point in common. It follows that

$$AB : AB' = AC : AC'.$$

We now add to our assumptions another one. $n+1$ points determine, as already stated, a plane space S_n, and besides a certain pyramid of n dimensions; of which we assume that it shall possess magnitude. Let the $n+1$ points be A_1 . . . A_{n+1}. A_2 . . . A_{n+1} determine a certain space S_{n-1}. Draw any line through A_1. It cuts S_{n-1} in a point B. Choose A'_1 on this line so that $A_1B = BA'_1$. Then the two points A_1, A'_1 have an exactly symmetrical position to S_{n-1}. No property can be valid for the one which is not valid for the other (as long as no elements are introduced to disturb the symmetry). We cannot therefore assume that one of the two pyramids, determined respectively by A_1 and the A_2 . . . A_{n+1} or A'_1 and A_2 . . . A_{n+1}, should be larger than the other. Now the *locus* of points A'_1 is, according to the foregoing, a parallel Σ_{n-1} to S_{n-1}. It follows: The magnitude of the pyramid is dependent (1) on n of its points (2) and the distance of the $n+1^{st}$ from the plane space determined by these n points.

What we have in mind, when we speak of the magnitude of a pyramid, will come out clearer when we give a theorem of addition. Let X be any point collinear with and intermediate between A_2 and A_3. Then we say:

The pyramid determined by A_2X and any other points + the pyramid determined by XA_3 and those other points = to the pyramid formed by A_2A_3 and the rest of the points.

This explanation, combined with the above, shows that the magnitude of a pyramid is equal to some constant multiple (say $\frac{1}{n}$) of the product of the magnitude of the pyramid A_2 . . . A_{n+1}, and the distance of A_1 from the space fixed by the other points. We shall write this number $(A_1A_2 \ldots A_{n+1})$. (A_1A_2) is simply the distance of the two points, and according to a convention necessitated by considerations of continuity, we assume

$$(A_1A_2) + (A_2A_1) = 0.$$

Generally, if we transpose any two letters, the magnitude designated changes sign.

If A, B, C are three collinear points, and if we designate by the single letters A, B, C the distances from these points of any fixed point O on that line, then we have identically

$$(AB)C + (BC)A + (CA)B = 0.$$

This is an algebraical identity easily established. The same holds also when the single letters A, B, C are made to denote the distance of these points from any space Σ, which either is parallel to line ABC, or has with it a point in common, as is easily established by proportions.

If between three points of a line such an equation exists, this must be true also for $n+2$ points in a S_n. The proof of this by induction is perfectly easy Let for instance A, B, C, D, be four points in a plane, and let Σ be any space, that has with it a line in common. Join CD; it may meet AB in E. Then we have some linear identity

$$aA + bB + cE = 0$$

where a, b, c denote constants independent from Σ, and also

$$dC + eD + fE = 0.$$

Eliminating E, we obtain some linear identity between

A, B, C, D.

In order to determine the constants, let us assume the space Σ (which is permitted) to be parallel to the plane ABCD; then we have if

$$aA + bB + cC + dD = 0$$
$$a + b + c + d = 0.$$

If we place Σ so that it cuts ABCD in CD, and if then we make $a = (BCD)$, c follows $= (CDA)$. We therefore obtain

$$(BCD)A + (CDA)B + (DAB)C + (ABC)D = 0$$

and just so in the general case

$$(BCD \ldots L)A + (CD \ldots LA)B + (D \ldots LAB)C + \ldots = 0.$$

The use of the distances of points from variable plane spaces enables us to do away with fixed coordinate systems. The proof of projective theorems becomes perfectly lucid, while at each stage of the proceedings we are always able to give the geometrical significance of the constants employed. To give a few instances: Let $A_1 \ldots A_{n+1}$ be $n + 1$ points in a plane space S_n. Let P be any other point. We then have one linear relation

$$a_1 A_1 + a_2 A_2 + \ldots + a_{n+1} A_{n+1} + pP = 0.$$

Assume outside the space any point Q. Construct the plane spaces $QA_1 \ldots A_n$, $QA_2 \ldots A_{n+1}$, $\ldots$ $n + 1$ in all, and cut them by some line joining the residual point A_{n+1}, $A_1 \ldots$ respectively with a point R on the line QP. We thus obtain $n + 1$ new points $A^1{}_{n+1}$, $A^1{}_1 \ldots$, which joined give a plane space Σ_n, that cuts S_n always in one and the same plane cut S_{n-1}, however we may choose Q and R, which is related to P and the configuration of the A in a peculiar manner.

To follow the different steps indicated, let us assume

$$pP = qQ + rR$$

(the three points are collinear); therefore

$$a_1 A_1 + a_2 A_2 + \ldots + qQ + rR = 0.$$

Joining R with A_1, we obtain a line that contains the point $\frac{a_1 A_1 + rR}{a_1 + r}$, which as

$$a_1 + a_2 + \ldots + q + r = 0$$

is also $= \frac{a_2 A_2 + \ldots + qQ}{a_2 + \ldots + q}$, that is contained in the plane space $A_2 A_3 \ldots Q$.

$$A^1{}_1 \text{ is therefore } = \frac{a_1 A_1 + rR}{a_1 + r}.$$

Just so

$$A^1{}_2 = \frac{a_2 A_2 + rR}{a_2 + R}.$$

The line $A^1{}_1 A^1{}_2$ contains the point

$$\frac{(a_1 + r)A^1{}_1 - (a_2 + r)A^1{}_2}{a_1 - a_2};$$

that is

$$\frac{a_1 A_1 - a_2 A_2}{a_1 - a_2},$$

which is collinear with A_1, A_2. The plane space S_{n-1} contains therefore all the $\frac{n \,.\, n - 1}{1 \,.\, 2}$ points thus formed, and the proposition follows at once.

In a similar way it may be proved that, if two $(n + 1)$ pyramids in a S_n are in perspective, the intersection of corresponding sides, $\frac{n + 1 \,.\, n}{1 \,.\, 2}$ in all, are all contained in a S_{n-1}. We prove this simply for $n = 2$, which is sufficient to exhibit the general way of proceeding. Let A B C, $A^1 B^1 C^1$ be two triangles in perspective; let AA^1, BB^1, CC^1 have point P in common. Then we must have

$$\begin{aligned} P &= aA + a^1 A^1 \\ &= bB + b^1 B^1 \\ &= cC + c^1 C^1. \end{aligned}$$

Join AB, $A^1 B^1$. Their intersection, from

$$aA + a^1 A^1 = bB + b^1 B^1$$

follows

$$\frac{aA - bB}{a - b} = \frac{a^1 A^1 - b^1 B^1}{a^1 - b^1}.$$

Now $\frac{aA - bB}{a - b}$, $\frac{bB - cC}{b - c}$, $\frac{cC - aA}{c - a}$, are obviously collinear.

Two plane spaces in general do not determine one magnitude only. Take, for instance, two lines in space. They have a distance, and form an angle. If their distance or the sine of their angle is $= 0$, they will be coplanar. If both are $= 0$, they will coincide. We have two magnitudes, because the system of two lines in space has two degrees of degeneration (coplanarity and coincidence). This is also generally the case, because geometrical magnitudes are nothing but the most suitable invariants, whose evanescence is the necessary and sufficient condition for the degeneration of the system to which they belong.

If two plane spaces A, B determine only *one* magnitude, we designate the same by (AB). Let A be a straight line, for instance, and B a plane space which has one point in common with A. From any point of A, say P, draw the perpendicular to B. Join B with point Q, common to B and A. Then the sine of ∠ Q is the magnitude denoted by (AB). Let A be a plane, having in common with B a line. From any point P of the plane draw the perpendicular on B, say PB, and from this point B the perpendicular on the common line BQ. Then again sin (∠ Q) = (A B), and thus generally. We determine the sign of the magnitude according to the rule

$$(AB) + (BA) = 0.$$

Let us now add another plane space C to the system A, B, such that both CA and CB determine only one magnitude. Then the whole system may determine an additional one, whose evanescence would signify that C belongs to the plane space fixed by A and B in conjunction, and is united with the space that A, B have in common. It is in fact the product of (AB) and the magnitude formed by C and the space AB, and will be written

$$(ABC)$$

In this way we proceed, obtaining the definition of a magnitude, which has the property that its evanescence is the necessary and sufficient condition for the degeneration of the system to which it belongs.

The magnitude in question may be formed in various ways, but the system being such that it can possess only one such magnitude, the different formations must always lead to one and the same result, with the exception of a constant factor. This factor must either be $+1$, or else -1, on account of the symmetrical way in which the magnitude is formed. If the system is one of straight lines through a point P, the magnitude in question has a special significance. Two triangles which have an angle in common, are in proportion as the product of the sides including this angle. Three lines in space which have a point in common and are not coplanar, form a corner. Cut a corner by two different planes. The two different pyramids are in proportion as the product of the three sides forming the corner. And so in general, as can be easily proved by induction. Therefore, if we have such a corner of n lines in a space S_n, and cut it by a space S_{n-1} the pyramid formed is = the product of the n sides extending from the vertex of the corner multiplied with a factor which is specific for the corner; and this latter factor is exactly the magnitude formed according to the rule given.

(It may happen that the formation of the magnitude, as given, leads to zero without giving a significant result. This is an indication that somewhere during the process one of the conditions of degeneration is fulfilled—for instance, when C belongs to the space AB. Then the process is the reciprocal one. We determine the magnitude formed by C and the space common to A and B. If that also is zero, then A, B, C belong to what is called a pencil. The simplest case of this kind is the system of three lines in a plane.)

Let A B C be three plane spaces belonging to a pencil; that is, let $(ABC) = 0$. Let D be any other plane space, which has an element with the pencil in common. Then we have again

$$(AB)C + (BC)A + (CA)B = 0,$$

where the single letters A, B, C in this identity denote the magnitude formed between each of these three spaces and the auxiliary one.

It will suffice to prove this for the case of three lines through a point P. Let Σ cut the pencil in a line S. Let A, B, C form with S the angles α, β, γ respectively, then the proposition amounts to

$$\sin(\alpha - \beta)\sin\gamma + \sin(\beta - \gamma)\sin\alpha + \sin(\gamma - \alpha)\sin\beta = 0,$$

which is nothing but the Ptolemäus theorem about four points in a circle.

Now again we may proceed to show, that between $n + 2$ elements A_i, for which, to be short $(A_1 A_2 \ldots A_{n+2}) = 0$, a linear relation must exist $\Sigma\, a_i\, A_i = 0$, where the a_i are certain constants. Of course, if not also some of the minors are zero, such as $(A_1 A_2 \ldots A_{n+1})$, this will be the *only* relation that can thus exist. We can therefore determine the a_i, by giving Σ exceptional positions. The result is again

$$\begin{aligned} (A_1 A_2 \ldots A_{n+1})\, A_{n+2} + (A_2 A_3 \ldots A_{n+1} A_{n+2})\, A_1 \\ + (A_3 \ldots A_{n+2} A_1)\, A_2 + \ldots = 0. \end{aligned}$$

Let $A_3 \ldots A_{n+2}$ form the space S, and the magnitude (S) then, making Σ identical with S, we obtain

$$(A_2 S) \,.\, (S)\, A_1 + (S A_1) \,.\, (S)\, A_2 = 0.$$

But $(A_2 S) = -A_2$ for this special position of Σ, and $(S A_1) = A_1$, therefore the test applies, and the theorem must be correct.

For such systems A_i, as we have considered, all projective properties will be corresponding to each other, and all metrical properties at least as far as they are dependent upon the interpretation of the constants employed. EMANUEL LASKER.

Ilkley, July 9.

P.S.—The same holds true, with slight modifications, for the only curved space that contains no exceptional elements, that is the surface of a globe of *n* manifoldness.—E. L.

The Feigning of Death.

THE discussion, a few months since, of the feigning of death in reptiles (vols. li. pp. 107, 128, 223, and lii. p. 148), induced me to experiment on the Currant Moth, whose powers of "shamming" are so familiar. The moth was first seized by one wing, and it at once feigned death; thereupon I cut off its head with a pair of scissors, and the *animal continued to feign death*. I use the expression advisedly, for absolute immobility was maintained for some seconds, and then violent fluttering ensued, causing the animal to rush wildly about the table, but failing to lift it into the air. In this condition any impulse, such as touching or pinching, induced a repetition of "shamming." After a strong stimulus the shamming was prolonged, and indeed a direct connection was obvious between the strength of stimulus and the length of period of quiescence. This power of response to stimulus was maintained for two days, and then weak fluttering set in for some hours, followed by death. Our entire ignorance of the physiology of the nervous system of insects renders it difficult to draw complete conclusions from these phenomena; nevertheless, it is difficult to conceive that volition can persist for forty-eight hours in a decapitated animal. We are forced then to conclude that here, at any rate, death-feigning is a purely reflex phenomenon, and that the sensory stimulus received by the surface of the body causes inhibitory impulses to arise reflexly from the ganglia of the central nerve chain, and prevent all movement of the locomotor muscles. In confirmation of this, it may be mentioned that denuding the wing of its scales over any area caused a marked diminution of sensitiveness over the area so treated. Since all stages between sensory hairs and ordinary scales occur in Lepidoptera, it is not unreasonable to assume that the scales still function as tactile end-organs, in spite of their modification subserving decorative purposes. OSWALD H. LATTER.

Charterhouse, Godalming, July 31.

Halley's Chart of Magnetic Declinations.

IN NATURE for May 23 and 30, 1895, are interesting communications from Dr. Bauer and Mr. Ward in reference to Halley's old chart of magnetic declinations.

I have a copy of this chart not referred to by either of these gentlemen.

It is bound in vol. i. of "Miscellanea Curiosa." This work was edited by Halley; it consists of three volumes, containing, in the main, reprints of papers read before the Royal Society. Vol. i. was published in 1705, and was printed by J. B., for Jeffery Wale and John Senex.

The chart is 7½ inches high and 13 inches long, and embraces just the circumference of the earth.

The title in the upper left-hand corner reads: "A new and correct Sea Chart of the Whole World, showing the Variations of ye compass as they were found Año 1700 with a view of the General and Coasting Trade Winds and Monsoons or shifting Trade Winds by the Direction of Capt. Edm. Halley."

In the lower left-hand corner is the note: "Capt. Halley's map of the World in two large sheets is sold by R. Mount and T. Page on Great Tower Hill, London."

The name "I. Harris, delin. & scu." is in the lower right-hand corner of the chart. CHARLES L. CLARKE.

New York, July 27.

THE ERUPTION OF VESUVIUS, JULY 3, 1895.

THIS recent disturbance at Vesuvius is interesting in several ways, and at one time had all the appearance of developing into as grand a display as that of 1872.

The last eruptive cycle of Vesuvius commenced on June 7, 1891, when I had the good fortune to be but a few hundred yards distant at the time the main bursting of the rift took place. The details of that eruption, with illustrations, can be referred to in my articles and reports.[1] We may briefly state that cycle as follows: the splitting of the whole of the great cone of Vesuvius by a radial rift which extended beyond the base for some distance across the Atrio del Cavallo. At the first moment a little lava issued from the upper part of the rift, but after a few hours all came from its lowest extremity in the Atrio, and continued to flow with practically no interruption for a period of nearly three years, or, more correctly, from June 7, 1891, to February 7, 1894. During that period no great quantity was given forth at any one time, so that no stream could attain much length before cooling. Though the amount emitted during that period is enormous, and if vesicularised into pumice and scoria would, I think, quite equal Monte Nuovo in volume. The consequence of this is, that a great and pure lava cone was built up in the Atrio, of low inclination (14°), and adding much to obliterate that interesting and characteristic feature of the volcano. Coincident with the formation of the rift, the central cone rapidly crumbled in, until a deep crater was formed which eventually attained over 150 m. in depth and diameter. It was at its greatest dimensions in February 1894, when the lava stopped issuing by the lateral outlet, and therefore commenced to rise in the chimney. The immediate result of that stoppage was that the formation of a cone was soon commenced at the bottom of the crater by the ejection of lava cakes. The growth of this new cone of eruption was so rapid that, when I visited and photographed the interior of the 1891 crater in November last, this was not above 60 or 70 m. deep, and the cone of eruption was rapidly increasing in height within it.

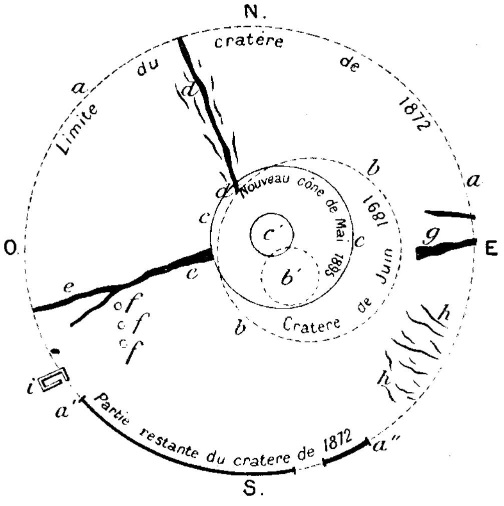

FIG. 1.—Diagram showing the actual state of Vesuvius, from a drawing by M. A. Bourdariat, after an earlier plan of mine (*La Nature*, June 8, 1895). (*a*) Limit of the crater edge of 1872; the part represented by a dotted line is that covered by more recent lavas of different dates. The parts *a'* and *a''* are still uncovered. (*b*) Crater of June 1891. (*b'*) Active vent of the 1891 crater. (*c*) New cone in process of formation (May 1895). (*c'*) Active vent of the cone on May 12, 1895. (*d*) Rift and vapour mouth of June 7, 1891, (*e*) Fissure emitting acid vapours on crater plain formed in the 1872 crater. (*f*) Very old hot-air passages and fumaroles. (*g*) Fissure of May, 1889. (*h*) Numerous fissures on the south-east edge of the crater plain. (*i*) Guides' shelter.

My friend M. Alex. Bourdariat has carefully observed the

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[1] "Il Vesuvio," *Corriere di Napoli*, June 10, 1891. "L'Eruption du Vésuve," *L'Italie*, Rome, June 13, 1891; *Le Figaro*, Paris, June 17, 1891. "The Eruption of Vesuvius," *Mediterranean Naturalist*, Malta, July 1 and August 1, 1891. "Lettre sur l'Eruption du Vésuve," *L'Italie*, Rome, July 18, 1891. "L'Eruption du Vésuve, visites d'exploration au Volcan," *La Nature*, August 8, 1891 (illustrated). "The Eruption of Vesuvius," NATURE, vol. xliv. pp. 160–161, 320–322, and 362 (illustrated). "Report British Association," 1891–92–93–94. "L'Eruzione del Vesuvio," *Rassegna delle Scienze Geologiche*, vol. i. Rome, 1891 (illustrated).